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ABSTRACT

This document describes the development and implementation of an open learning course for shift operators who work in British process industries. The course was developed collaboratively during 1979-82 by B.P. Chemicals Ltd. and Grimsby College of Technology and Arts, using the Business and Technician Education Council certification program. Following an abstract in German and a short introduction, the two collaborating parties are described. Open learning is described as learning for which there is often no entry requirements; learners can choose what to study, where and when to study, and what instructional materials to use; specially prepared packages of instructional materials are often used; and learners will have regular contact with a tutor and/or counselor. The training needs of B.P. Chemicals Ltd. (including the requirements that the course involve no time off work, have no academic entry requirements, be provided at no cost to students, and lead to a nationally recognized qualification) are listed, as well as the Grimsby College response to those constraints. The course is described in terms of units for three levels (mathematics, physical science, chemistry, instrumentation systems, communications studies, unit operations, fluid and heat transfer, safety, communication studies, plant technology, unit operations, plant combustion and steam, and student projects), learning objectives, materials, course organization, student recruitment for the pilot year, and dropouts among the pilot group. The next section describes the activities since the pilot year, including changes made in the course on the basis of student feedback. The document concludes with short sections on the value of the training to the company, the titles of student projects, and the costs of open learning. (CML)

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ZIFF PAPIERE 78

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OPEN LEARNING FOR PROCESS OPERATORS

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Hagen, Januar 1990

A B S T R A C T

David Geary legt hier einen kruzen Projektbericht vor, der aus zwei Gründen heute von großem Interesse für die Fachwelt sein sollte:

1. Groß-Systeme des Fernstudiums entwickeln sich immer weiter weg von der beruflichen Praxis.
2. Gerade in der politischen Umbruchsituation, die auch das Fernstudium in der DDR betreffen wird, scheint das Konzept des Open Learning ein geeigneter Weg zu sein, das durchaus hochentwickelte, praxisorientierte Fernstudium der DDR zu unterstützen.

Z I F F - P a p i e r e

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Open Learning for Process Operators

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Introduction

This paper describes the development and implementation of an open learning course for shift operators who work in the English process industries. The course was developed as a collaborative venture between B.P. Chemicals Ltd. and Grimsby College of Technology and Arts.

Grimsby College of Technology and Arts (GCTA)

Education in England is compulsory up to the age of 16 years when children may leave school to commence work or opt for a period (usually two years) of continuing education and/or training at a school, a local technical college or have work-based training sponsored by the Government. GCTA caters in the main for students in the age-range 16 to 19 years. However, in recent years there has been a steadily increasing number of more mature students, although the 16-19 age-group still forms the bulk of the student population.

The origins of the College are in vocational courses at craft and technician levels; however, during the past few

years the number of non-vocational and adult education courses has increased steadily. On completion of courses, full-time students frequently leave the College for Higher Education courses at Universities or Polytechnics. The majority of the part-time students are employed by local industry and attend the College for about one day per week to follow vocational studies (so called "day release"); the remaining part-time students may be unemployed, housewives or involved with Government training schemes. In addition to college-based courses, the College provides short training courses to industry, often delivering the courses on a company site rather than at the College.

The majority of the funds needed by the College are supplied by the Local Authority and the Government, although the College is being encouraged to also earn income by selling its services to industry; income derived in this way is currently in the range 5-10% of the total income of the College.

The College offers a range of open learning courses to industry; all such courses are paid for by industry (so called "full cost" courses).

The current enrolment of the College is 1046 full-time students, 4170 part-time students and 550 open learners; the students are supported by 230 full-time lecturers.

B.P. Chemicals Ltd. (B.P.)

The B.P. site in Hull (about 60 kilometres from the College) manufactures a wide range of chemicals using both continuous and batch processing methods. The plant is capital intensive and there is a rolling programme to update both processes and equipment.

During the period of the course development (1979-82), the site work-force consisted of about 1500 employees, including 500 process operators and 400 tradesmen (those who have completed a four- or five-year apprenticeship).

Open Learning

There are many definitions of Open Learning, but none is universally accepted. In essence, Open Learning schemes open up new opportunities for people to learn, giving access to courses to which they might otherwise be barred. The following are features of Open Learning:

* Perhaps no entry requirements
* The learner chooses what to study
* The learner can study when and where it is convenient, and at a pace to suit him/her
* The learner can often choose the instructional medium
* The learner can often choose his own learning objectives and how these are to be assessed

In general, Open Learning programmes use a range of specially prepared packages. Such packages often comprise units, modules or lessons, each with a nominal study time of only a few hours or days. Completion of a package may lead to a nationally recognised qualification.

Packages make use of a wide range of media including

* text-based materials
* audio and visual material
* computer-based training
* practical kits
* interactive video

In general, learners will have regular contact with a Tutor and/or Counsellor and, hopefully, fellow learners.

The Training Needs of BP

Up to about ten years ago, operators at BP were unlikely to have relevant academic qualifications, and frequently would have no formal qualifications at all; in general, training was given "on the job". It was increasingly apparent due to the continuous updating of processes and equipment, that shift process operators would benefit from suitable vocational education to support changing on-site technology. For economic reasons, the Company did not have the manpower to release personnel for job-related education during normal working hours, a problem compounded because the operators were employed on a shift system or rotas. Thus in-house company training and traditional modes of education (e.g. day-release) were not possible. With these constraints in mind, BP approached GCTA* to design suitable job-related education. The proposed course had the following criteria:

* no time off work
* no academic entry requirements
* no cost to students
* course to lead to a nationally recognised qualification

*In 1979 the College title was Grimsby College of Technology

The College Response

Of the criteria, the one which posed difficulties was that the learners could have no time away from their work. The potential learners were spread between five shifts so that collecting them together for face-to-face tuition at any one time was virtually impossible; mounting five separate face-to-face courses to cater for all the shifts would have proved to be very costly, particularly since the total number of learners in the pilot year of the course was to be limited to fifteen. The answer then was for the learners to become involved in Open Learning.

In 1979, the term "Open Learning" was unheard of - apart from the U.K. Open University courses, there were just traditional correspondence courses available (these involved learning from text-based materials with tuition only provided by correspondence and telephone). Experiences of traditional correspondence courses suggested that a course of this nature would result in an unacceptable drop-out rate, particularly during the first year of study; hence another reason for opting for Open Learning.

The recommended qualification was the BTEC* award; this qualification is at technician level as opposed to the alternative craft level award of the CGLI**. Neither option

* BTEC: Business and Technician Education Council
** CGLI: City and Guilds of London Institute

had academic pre-requisites, although in the case of BTEC courses it was possible to exempt learners from part of the course if they had existing academic qualifications.

As regards tuition fees, these were to be paid by the Company, without any Government or regional subsidy.

The BTEC Programme

The content of the programme was established through a collaboration between BP, BTEC and the College; the programme title was The National Certificate in Process Technology. The programme required study of the equivalent of fifteen units. There were three levels of units, namely levels 1, 2 and 3; level 1 was the first to be studied. Figure 1 lists the units in the programme.

Fig 1 **NC in Process Technology**

Level 1

Mathematics

Physical Science

Chemistry

Instrumentation Systems

Communication Studies

Level 2

Mathematics

Chemistry

Unit Operations

Fluid & Heat Transfer

Safety

Communication Studies

Plant Technology

Level 3

Unit Operations

Plant Combustion & Steam

Project

A validation requirement by BTEC was the preparation of a syllabus for each unit to be studied. Each syllabus gave both general and specific learning objectives, and each specific objective was made clear as to the level of learning needed by use of carefully chosen verbs (Fig 2).

Fig 2 **Example of Learning Objectives**

1 Evaporation

Appreciates the underlying principles involved in evaporation and describes the basic plant used for the unit operation

1.1 Differentiates qualitively between drying, distillation and evaporation

1.2 Classifies evaporators into direct-heated and indirect-heated evaporators

1.3 Describes the steam boiler as a typical example of a direct-heated evaporator

1.4 Explains the relative advantages of vacuum and atmospheric operation

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1.8 Defines the economy of an evaporator

Learners with previous relevant qualifications could be exempted from study of up to 7.5 units of the programme. So what is meant by a unit? A unit has a nominal class-room teaching time of 60 hours; however, by open learning, study of a unit could be expected to take as long as 100 hours. A unit is assessed in isolation of all other units and once passed, the student is credited with the unit. Each unit is assessed by written homeworks, phase tests and end tests. A phase test targets about one-third of a unit and an end test covers the whole unit. Contributions to the final unit assessment also come from the homeworks and practical reports. A typical assessment profile could be homeworks and practical work with a 20% weighting, two phase tests each contributing 20% and the end test making up the final 40%. Each part of the assessment has a minimum pass mark of 40%, but the aggregate mark to achieve a pass grade of the unit must reach at least 50%. Dependent on the mark, a successful student could be awarded a Pass, Merit or Distinction. Figure 3 summarises this typical assessment.

Fig 3 **Unit Assessment**

Homeworks, Practical Work	20%
2 Phase Tests at 20%	40%
End Test	40%
	100%

Pass mark for each part is 40%

Overall pass mark is 50%

50 - 64% Pass

65 - 84% Merit

85 - 100% Distinction

Apart from the National Certificate award, students who do not complete the programme but who successfully complete some units are awarded a BTEC Certificate of Achievement for those units.

The Open Learning Materials

With a nominal total study time of 900 hours, it was decided to opt for materials which were almost wholly text-based, developments in other media being much more costly. The materials' development was anticipated to be both time-

consuming and resource demanding, so that we decided to make use of existing open learning materials where possible. However, the College had to prepare materials for the bulk of the course. Fortunately, during the infancy of the materials' development, the British Government launched the Manpower Services Commission (MSC) and part of the Commission was an Open Learning Branch whose brief was to assist the development of open learning materials.

The College was given a grant of £445,000 over a three year period to help with the development of its' open learning materials; this pump-priming enabled a more professional presentation of the materials than would otherwise have been possible.

The materials were, in the main, text-based, with emphasis on activities and exercises to break up the text and self-assessment questions at the end of each lesson (segment) to enable the learner to assess his understanding of the course material. A segment represented about one to two hours of learning time, there being up to sixty segments in a Unit. The title page of a segment indicated the contents of the segment and outlined its objectives. An answer to each Activity was given on a following page. Similarly, answers to Self-Assessment Questions were included in the segment.

On-site experimental kits and occasional day schools at the College were provided for the practical elements of each unit. Some of the assignments were designed to encourage learners to become involved with unfamiliar site operations and to discuss these with colleagues.

Course Organisation

It was decided to follow the College academic year as far as tutor support was concerned. Learners were asked to study a maximum of three units per year (a nominal study time of 180 hours) so that the full course would take about 5 years to complete. It was thought that the three unit target would involve students in about 6-10 hours study per week. Weekly face-to-face on-site tutorials were made available, the time of these bridging the day-time shift change time (2.00 pm) so that those coming on a shift and leaving a shift could drop in to the Company Training Centre for help or to collect learning materials. In addition, those on "days-off" or on a shift change period could also make use of the facility. Learners unable to attend a tutorial could, if necessary, contact a tutor at the College by telephone.

All students were given clear timetables to pace their study, detailing the times by which homeworks were to be completed and when tests were available. All tests were

offered on-site during the tutorial sessions and alternative dates were given to cater for those unable to attend on a specific date. Materials were provided in study packages and distributed during tutorial sessions or through the Company's internal mailing system. Each package consisted of about six-weeks' material, enough to allow learners to organise their study over the period in their own way, but not so much as to overwhelm them. As will be appreciated, we made a conscious decision to pace the learners' study-rate, rather than to allow them to self-pace their learning. In addition to the tutor input, it was considered important to have recognisable Company support and the Training Officer agreed to act as an on-site Counsellor and Tutor for some of the units.

Recruitment - Pilot Year

Notices were posted throughout the Company-site inviting applications for the course. All applicants were interviewed to discover the level of their determination and to explain to them the problems of studying, in particular of studying by Open Learning; these problems included:

* the difficulties of coping with the first two or three months
* the difficulties of adapting to new learning methods
* the length of time since they last studied
* having to organise their domestic environment for home study

Following the interview there was a "cooling-off" period of about one month before learners were invited to start the course. Those learners who started were given an induction course to help them to learn how to study by open learning and to outline approaches to studying particular units.

The first group to enrol on the course was limited to fifteen operators from the fifty applicants. The learners were selected from a wide range of backgrounds and previous educational attainment. The age range was 25 to 45 years and the qualification range was from "none-whatsoever" to a University Degree in Education. It is interesting to note that regardless of background and age, all this group completed the first year of the course, all doing equally well in their examinations. It seemed that the chance of obtaining qualifications and the notion of self-improvement proved to be great incentives, and that study for its own sake was also a very important element. Promotion prospects were also considered to be enhanced by taking the course.

Drop-Out - Pilot Group

Of the fifteen original recruits to the course, seven have now received full National Certificates and one is still completing the course. Of the seven who left the course, two left the Company, those remaining dropping out at various stages but gaining BTEC Certificates of Achievements for units passed. All those learners who dropped out did so for what seemed to be good reasons, and no learner left his studies without prior consultation with his Counsellor.

Overview - To Date

Since the commencement of the course in 1982, the range of Open Learning courses delivered to Company employees has expanded. The current enrolment is of 51 students, 40 of whom are studying for National Certificates.

Has the programme been successful? Educationally, the pilot group has been most successful, all students having gained National Certificates or Certificates of Achievement listing Units passed. The drop-out rate of students in later groups was been between 30% and 50% during their first year of study; subsequent drop-out rates for students who have

completed their first year were very much lower. The annual recruitment is of about 15-20 students.

Feedback on the course was considered to be vital. A course team consisting of tutors, the Company counsellor and learners has met annually since the first year of the course, its purpose being to review the course. In addition, there has been constant dialogue between learners and tutors, and learners have been encouraged to comment on each segment of learning material. As a result, changes in both the course presentation and the open learning materials have been proposed and some have been implemented. For example, it was soon clear that during the first three months of the course the three-unit study took longer than eight hours a week; also phase tests had to be offered at three or more different times to cope with the increasing number of learners. Moreover, learners not exempt from parts of the course currently have to study for five years before receiving their National Certificate - a time considered too long to wait to achieve their goal. As a result, it is hoped to cut the total study time to four years, whilst giving more back-up in the initial stages when learners are still getting used to intensive study. The open learning materials themselves are continually monitored to cut down areas of potential confusion.

Value of Training to the Company

It is difficult to measure success for the Company. There is a general feel that studying has sharpened the minds of the learners and that this has improved their flexibility, particularly when having to adapt to new technology and processes. Certainly, being involved with the course has been considered as part of promotion procedures and promotion potential has been seen to be enhanced for those on the course. However, it should be appreciated that the more able employees generally volunteered to take the course, anyway, and it should not be assumed that being on the course itself necessarily contributed to an upgrading.

The third level Project Unit has provided an indicator of success for the company. All of the projects undertaken have concentrated on plant problems and many of the projects have made proposals to improve plant performance. Several proposals have been implemented, and one in particular has the potential to save the company in excess of £30,000 per year. Figure 4 gives titles of some of the projects.

Fig.4 **Project Titles**

* To examine product quality, feed-rate and energy with a view to optimising the relationships between feed-rate and steam consumption.

* To de-bottle a limiting distillation column.

* The use of warmed cooling water running to drain as pre-heat.

* Energy savings by rearrangement of steam and condensate systems.

Costs of Open Learning

The estimated cost of the programme to companies similar to B.P. is about £275 per 60-hour unit completed, that is, about £4,100 for the full National Certificate course.

The College can only offer Open Learning courses on a full-cost basis; this is because the Local Authority will not subsidise the activities. Whilst companies can generally afford to pay for Open Learning courses, an individual who has to pay for a course such as the National Certificate in Process Technology would need to find £2,000 - £2,500 (about £150 per unit; there would be very much less personal tutor support for the individual learner than for those involved in company schemes. Other Authorities in the U.K. do provide a subsidy for Open Learning courses which considerably reduces costs; however, materials still need to be paid for by learners and they can be quite expensive e.g. £70 for a module of text-based materials and up to £500 for materials using a kit or computer-based learning.

Conclusions

The development of the Open Learning programme for BP has proved to be very successful; the programme is in its seventh year and there are currently about fifty learners

involved. The College is now using the same programme with most of the major chemical companies in Humberside, and other colleges in England and Wales are using the open learning materials for similar programmes.

It is evident that open learning courses of this kind enable shift process operators to study for nationally recognised qualificiations which would otherwise be out of their reach.